Infectious & Vector-borne Diseases

Vector-borne disease = a disease which is transmitted by a biological agent (often an insect)

Vector = an organism which serves to transfer a disease-causing organism (pathogen) from one organism to another

Infectious diseases are one of the leading causes of death worldwide, and account for a quarter to one-third of all deaths. The spread of infectious diseases is a result of both human and other factors including rapid population growth, an increase in drug-resistant microbes, mutations in pathogens, lack of effective antibiotics, environmental degradation, growth of mega cities and settlements with insufficient health care facilities, increased human travel and trade, human lifestyle choices, land-use changes, inappropriate use of pesticides and antibiotics, political/social disruption, and regional climate effects.

It has also long been known that there are strong linkages between the physical and biological environment and the spread of infectious and vector-borne diseases. NASA is carrying out a program to significantly improve the use of our data, science and technologies to better understand the links between infectious and vector- borne diseases and factors such as temperature, rainfall, wind, soil moisture, humidity, vegetation, solar radiation, extreme weather events, and natural disasters.

I. Examples of Health Impacts

- Malaria
- Yellow fever
- Dengue fever
- River blindness
- Filariasis
- Schistosomiasis
- Encephalitis
- Rift Valley Fever
- Cholera
- Lyme Disease
- West Nile virus
- Scrub typhus

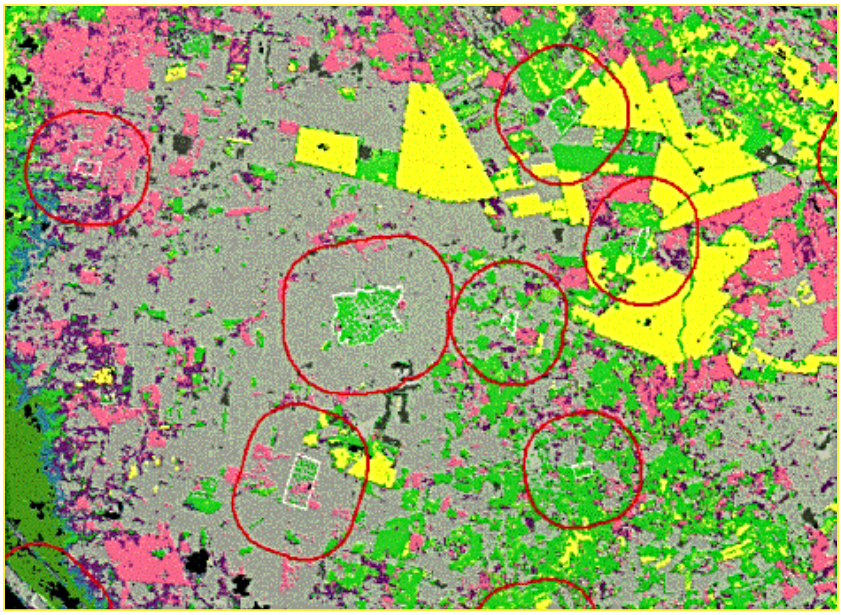
II. Mechanism Causing Health Effects

Vector-borne & infectious diseases are emerging or reemerging as a result of

- Changes in public health policies
- Insecticide and drug resistance
- Demographic and social changes
- Genetic changes in pathogens and vectors
- Inappropriate water engineering (e.g., irrigation)
- Poor management of water resources and wastes (e.g., poor sanitation)Global warming

Many vectors are sensitive to weather/climate/environmental conditions

- Temperature
- Land cover/use
- Rainfall
- Water bodies/flooding
- Humidity/atmospheric dryness
- Vegetation/crop
- Soil moisture/type
- Urban/human settlements
- Elevation
- Sea surface temperature



Portion of Mexico Study Area with 1 km Buffers

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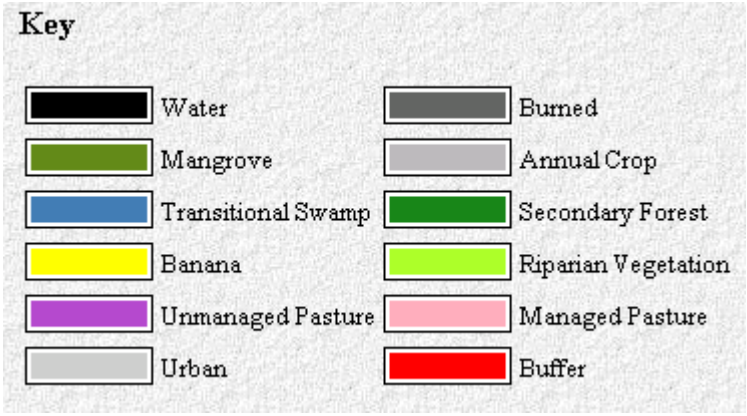


Beck *et al* at Ames Research Center employed GIS and Landsat TM imagery to determine Mexican villages that were at high and low risk for malaria transmission, as defined by mosquito abundance. The study area was classified into eleven different land covers (e.g. mangrove, inland water). Villages were mapped and given a 1-km buffer zone (the flight area of mosquitoes). The results of the study showed that out of the eleven land cover classifications, villages near the unmanaged pasture and transitional swamp classes were at higher risk of malaria transmission.

Beck, L.R., M.H. Rodríguez, S.W. Dister, A.D. Rodríguez, R.K. Washino, D.R. Roberts, and M.A. Spanner. 1997. Assessment of a remote sensing based model for predicting malaria transmission risk in villages of Chiapas, Mexico. Am. J. Trop. Med. Hyg. 56(1):99-106.
Beck, L.R., M.H. Rodríguez, S.W. Dister, A.D. Rodríguez, E. Rejmánková, A. Ulloa, R.A. Meza, D.R. Roberts, J.F. Paris, M. Spanner, R.K. Washino, C. Hacker, and L.J. Legters. 1994. Remote sensing as a landscape epidemiological tool to identify villages at high risk for malaria transmission. Am. J. Trop. Med. Hyg. 51(3):271-280.

III. Satellite Sensors – Examples

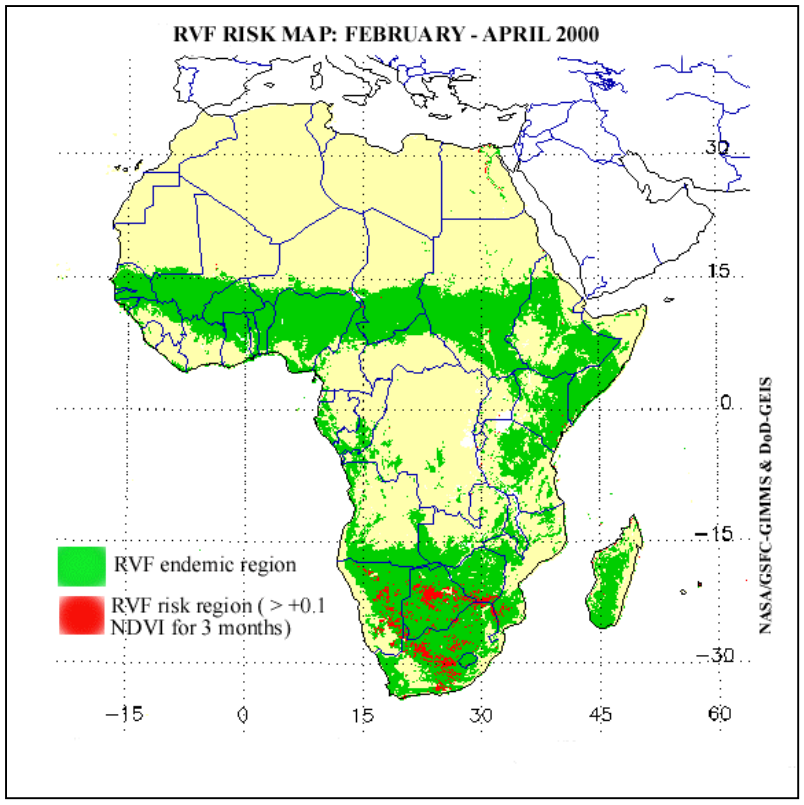
Land Cover/Use & Vegetation

- Landsat MSS – 79-82 m, 16-18 days
- Landsat TM – 30 m for Bands 1-6, 120 m for Band 7, 16 day
- Landsat ETM+, like TM but also with 15m panchromatic band
- Ikonos – 4 m multispectral, 0.82 m panchromatic, 14 days maximum
- SPOT – 20 m multispectral, 10 m panchromatic.

Meteorological & Land Cover/Use

- .NOAA AVHRR – 1.1 km, 4 km, 14.5 days
- MODIS: 0.25 km for Bands 1-2, 0.5 km for Bands 3-7, 1km for other bands, 16 days.

NDVI *(Normalized Difference Vegetation Index* = relative measurement of amount of sunlight that plants use for photosynthesis*) primarily derived from AVHRR measurements*



Mapping Potential Rift Valley Fever (RVF) Outbreaks using AVHRR-NDVI Data

Rainfall

- TRMM: PR 4.3 km, TMI 5-45 km, VIRS 2.1 km 16 days
- Radarsat's SAR (measures through rain and cloud): 30-240m

IV. Data Availability

AVHRR – EDC (http://edc.usgs.gov), Goddard DAAC http://daac.gsfc.nasa.gov)
Ikonos – Space Imaging, Inc. (http://www.spaceimaging.com)
Landsat – EDC (http://edcwww.cr.usgs.gov)
MODIS, TRMM – Goddard DAAC (http://daac.gsfc.nasa.gov)
Radarsat SAR – Alaska SAR Facility (http://www.asf.alaska.edu)
SPOT – SPOT Image Corporation (http://www.spot.com)